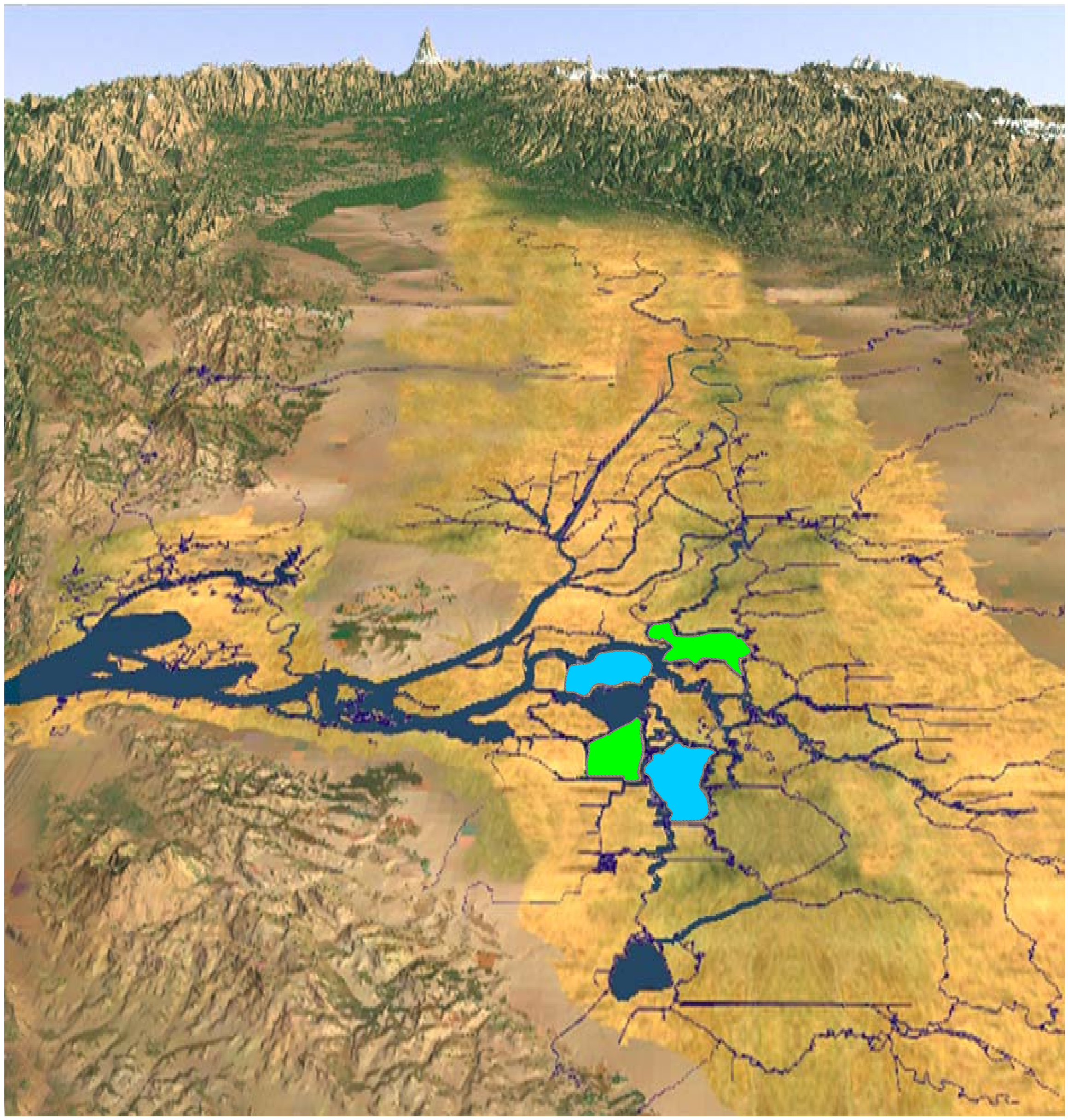
INTEGRATED STORAGE INVESTIGATIONS

IN-DELTA STORAGE PROGRAM
DRAFT REPORT ON ECONOMIC ANALYSIS



CALFED BAY-DELTA PROGRAM

May 2002

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Chapter 1
SUMMARY

1.1 Introduction

Two types of economic analysis were done for this study. First, benefit and cost information was developed to evaluate the economic justification for the proposed project alternatives. Second, a project area economic impact analysis was made to disclose the potential for both positive and negative impacts to the economy of the local area. While the former analysis is traditionally done using only direct costs and benefits, the later analysis considers indirect and induced local economic effects—the "ripple" effects.

The use of direct benefits and costs for economic justification avoids the difficulty of developing indirect and induced effects for, in this case, the areas benefiting from the additional water supply reliability provided by the proposed project. The assumption is made that if the direct benefits exceed the direct costs, there is a net gain when all of the indirect and induced effects throughout the State are taken into account.

1.2 Costs and Benefits

Table 1
TOTAL CAPITAL AND EQUIVALENT ANNUAL COST DEVELOPMENT FOR IN-DELTA STORAGE
(Millions of 2001 dollars)

Alternative	Base Construction Estimate	Mitigation Monitoring & Regulatory Costs	Project Total Construction Cost	Mobilization Cost	Contingency Cost	Engineering, Legal & Admin Cost	Total Project Cost	Forgone Investment Adjustment	TOTAL CAPITAL COST	Annual Capital Cost	Annual O&M Cost	EQUIVALENT ANNUAL COST	UNIT COST $/Acre-ft
A	B	C	D	E	F	G	H	I	J	K	L	M	N
			B + C	.05 x D	0.2 x D	.25(F+D+E)	D+E+F+G		H+I			K+L	
Re-Engineered Delta Wetlands	402.9	21.0	423.9	21.2	84.8	132.5	662.4	66.8	729.1	46.3	8.3	54.6	430
Bacon Island and Victoria Island with connection to Clifton Court	489.2	21.0	510.2	25.5	102.0	159.4	797.2	78.5	875.7	55.6	8.4	63.9	511
Webb Tract and Victoria Island with connection to Clifton Court	480.3	21.0	501.3	25.1	100.3	156.6	783.2	77.4	860.6	54.6	8.3	62.9	503

1.2.1 Project Costs

The annual cost is the sum of the three elements: (1) the capital recovery cost (including regulatory costs and an adjustment for foregone investment value), (2) property tax loss in-lieu property tax payments for loss of agriculture, and (3) the recurring annual costs. The first element includes the amortized total capital cost. The second element includes the loss of revenues due to loss of agricultural lands and in-lieu payment. The third element includes operation and maintenance costs as well as energy costs incurred for the project operations.

- Capital Recovery - Annualized capital costs were developed for each of the proposed projects. This is based on the total capital costs amortized over a fifty-year period with an assumed discount rate of 6 percent.
- In-lieu property tax payments
- Recurring Annual Operation and Maintenance Costs: These costs include the following items.
  - Levee maintenance
  - Intake and Outlet structures maintenance including pumping stations, gate units, siphons and fish screens for both, reservoir and habitat islands.
  - Pumping Energy costs
  - Seepage control systems maintenance and monitoring
  - Water quality monitoring, and
  - Environmental monitoring including wildlife and habitat monitoring.

Annual Cost of Development for in-Delta storage alternatives is also given in Table 1.

1.2.2 Project Benefits

Project benefits to be included in economic evaluation are:

- Additional SWP/CVP System Exports for urban and agricultural use
- Contribution to meet CVPIA Requirements including South of Delta Refuges
- Additional Joint Point Diversion Benefits
- Environmental Water Account
- Banking for Water Transfers
- Recreational Benefits

1.2.2.1 Urban and Agricultural Water Supply Benefits

To estimate the urban and agricultural water supply economic benefits two models were used the major portion of the benefits. An urban economic evaluation was performed using the DWR's Least-Cost Planning Simulation Model (LCPSIM) while the agricultural benefits were evaluated with the Central Valley Planning Model (CVPM).

Urban Benefits Study Major Criteria and Assumptions:

- Benefits in relation to base deliveries include 2020 impacts on shortage related costs and losses and on the economic justification for adding additional local reliability from the available water use efficiency options (e.g., water recycling). The benefits of any alternative are determined by the change in total avoided costs and losses: shortage-related and related to the use of local water use efficiency options.
- The conservation options used in LCPSIM are beyond those expected to be implemented by 2020 under the urban Best Management Practices MOU.
- Regionally, the San Francisco Bay Region is expected to be at a relatively high level of reliability in 2020 after the assumed adoption of economically justified local water conservation and supply augmentation measures in the context of the assumed availability of local carryover storage. Consequently, SWP deliveries available under contract and interruptible deliveries that were not of net economic value to the region (hereafter referred to as unallocated deliveries) were assumed to be available to augment SWP South Coast Region urban deliveries.
- Because of the level of local reliability that will be justified in 2020 within the region and the assumed availability of local carryover storage, the unallocated San Francisco Bay Region deliveries, SWP supplies available under contract, and interruptible supplies not of net economic value to the South Coast Region were assumed to augment SWP agricultural deliveries. The incremental unallocated deliveries produced by the project were assumed to augment CVP agricultural deliveries.

- Supplies available to, but not delivered for SWP urban use generated by in-Delta storage can be retained for CVPIA refuges water or can be credited to CVP for agricultural uses. For this study, the deliveries were credited to CVP agricultural users. This logic is meant to model one potential outcome of market based future water allocation negotiations between urban and agricultural users (in this case, an unconstrained “free-market” bookend.)
- Although the implementation of urban water conservation measures reduce the frequency and magnitude of shortages, demand hardening effects are assumed to cause an increase in economic losses when water shortages do occur. Since the already implemented conservation measures (assumed to be less costly than the remaining conservation options) are no longer available for shortage management, the value of new supply is therefore increased during shortage events.
- Reliability benefits for the Central Coast Region, an area not covered by the LCPSIM model, was interpolated from the results produced by LCPSIM for the San Francisco Bay Region.
- Benefits of in-Delta storage to urban users of SWP supplies in the San Joaquin Valley were based on the cost of existing local groundwater operations.

Agricultural Benefits Study Major Criteria and Assumptions:

- Both short-run and long run responses to changes in water resource conditions will be evaluated. The purpose of the long-run analysis is to estimate average economic conditions after farmers have made long-term adjustments to changes in supply availability and economic conditions. The purpose of the short-run analysis is to estimate acreage, crop mix, and water use during above and below average hydrologic events, given farmers’ best possible responses to the temporary situation.
- The potential sources for agricultural in each region are identified as CVP water service contract supply, CVP water rights and exchange supply, State Water Project (SWP) supply, local surface supply, and groundwater.
- In the base case (i.e., no action alternative), unallocated interruptible and unallocated contract SWP urban deliveries are allocated to San Joaquin Valley SWP and CVP agricultural contractors in proportion to their deliveries under their respective contracts.
- The additional unallocated interruptible and unallocated contract SWP urban deliveries produced by the project are used to augment CVP agricultural deliveries.
- To reflect the reasonable (and conservative) assumption that planted acreage would not be based on interruptible deliveries because of planting decision constraints, planted acreages are held to the amounts, which resulted from the evaluation of contract deliveries. In this manner, only reductions in local agricultural ground water pumping costs due to the in-lieu surface supply would be the benefit of the interruptible deliveries.

Shown in Tables 2 and 3 are the results of the LCPSIM evaluation of urban water use benefits for the San Francisco and South Coast Regions, respectively. Shown in Table 4 are the results of the CVPM model evaluation of the benefits of agricultural deliveries.

Table 2.
San Francisco Region Benefits of In-Delta Storage

Regional Economic Benefits	Value
Avg Incremental Available Urban Supply (TAF)	8
Avg Incremental Unallocated Urban Supply (TAF)	1
Net Avg Incremental Delivered Urban Supply (TAF)	7
Avoided Costs/Losses ($1,000)	$4,922
Avg Value of Incremental Urban Supply ($/AF)	$699

Table 3.
South Coast Region Benefits of In-Delta Storage

Regional Economic Benefits	Value
Avg Incremental Available Urban Supply (TAF)	60
Avg Incremental Unallocated Urban Supply (TAF)	24
Net Avg Incremental Delivered Urban Supply (TAF)	36
Avoided Costs/Losses ($1,000)	$25,475
Avg Value of Incremental Urban Supply ($/AF)	$709

Table 4.
Total Agricultural Supply Benefits

Supply Category	TAF			Value
	SWP	CVP	Total	($1,000)
Base Allocation				
Contract Deliveries	28	3	31	$2,106
Interruptible Deliveries	13	0	13	$682
Incremental Allocation				
Contract Deliveries	0	24	24	$1,750
Interruptible Deliveries	0	1	1	$97
Subtotal				
Contract Deliveries	28	27	55	$3,856
Interruptible Deliveries	13	1	14	$779
Total	41	28	69	$4,635

Table 5
Summary of Annual Benefits

Benefit Category	TAF SWP	TAF CVP	TAF Total	Value ($1000)
Agricultural				
Supply	41	28	69	$4,635
Water Market Transfers				
SF Bay Region [1]				-$5
South Coast Region [1]				-$62
Total	41	28	69	$4,568
M&I Supply				
SF Bay	7		7	$4,922
South Coast	36		36	$24,475
Central Coast	2		2	$1,106
San Joaquin Valley	4		4	$405
Total	49		49	$30,908
Environmental			12	$1,549
Total Supply Benefits	90	28	130	$37,025
Recreation				
Alt 2				$674
Alt 3				$771
Avoided Levee Maintenance Cost				
Alt 2				$700
Alt 3				$919
Total Benefits				
Alt 2				$38,399
Alt 3				$38,715

[1] Average annual quantities are much less than 1,000 AF

1.2.2.2 Additional Benefit Evaluations

Other benefits evaluated included EWA, recreation, and avoided levee maintenance cost benefits. Shown in Table 5 is a summary of all in-Delta storage project benefits.

1.2.2.3 Further Benefit Analysis. Further analysis is recommended to evaluate the following benefits:

Contribution to CVPIA(b)(2). The following assumptions will be used to evaluate CVPIA(b)(2) benefits.

- The net benefits to CVPIA will be determined from the reduction in South of the Delta SWP and CVP exports due to implementation of the CVPIA requirements.
- CVPIA water banking will be considered as a benefit to the CVP.

- Any re-allocated water from urban sector can be given credit as the CVPIA water. For example, supplies turned back from SWP MWD use can be transferred to CVPIA Refuges.

Environmental Water Account (EWA) Benefits. The following assumptions were (or will be used) to evaluate EWA benefits.

- 10% of exports to be released as environmental water from DW Project as per Biological Opinion.

- The net benefit to EWA will be based on any potential benefits in addition to CVPIA and exports.

- Information on EWA actual payments in Year 2000 by State and Federal agencies will be used in conjunction with information from DWR EWA staff to assess economic value of EWA benefits.

Banking for Water Transfers. Economic value of interim banking for water transfers in in-Delta storage will be evaluated on qualitative basis.

CVPIA Benefits. Further modeling studies are required to evaluate the impact of in-Delta storage operations integration with CVPIA requirements.

Water Transfers and Banking. There are no agreements between water users that can be applied to assessment of benefits. A storage apportionment agreement needs to be developed for this project.

1.3 Delta Economic Impacts

Changes in local economic activity evaluated in this section arise from:

- Loss of expenditures for crop production.
- Loss of expenditures on existing levee maintenance regime.
- Expenditures on operations and maintenance of the proposed project facilities (including recreation facilities).
- Expenditures related to additional recreation days produced by the proposed project.

The impact numbers generated for these evaluations represent the sum of the direct, indirect, and induced economic effects and were developed using a MIG IMPLAN model set up for Contra Costa and San Joaquin counties. The income effects shown are for employee compensation and proprietor's income effects, those effects directly linked to employment. Along with effects on income from rental property and capital investments, these effects make up total expected household income effects.

Table 6.
NET LOCAL EMPLOYMENT AND EMPLOYEE AND PROPRIETOR INCOME EFFECTS

	Employment			Income ($1,000)		
Effect Category	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 1**	**Alt 2**	**Alt 3**
Agricultural Production	-345	-345	-636	-$8,893	-$8,893	-$16,863
Current Levee Maintenance	-19	-19	-25	-$749	-$749	-$983
Recreation	36	36	42	$887	$887	$1,029
Operations and Maintenance	179	132	134	$7,917	$5,768	$5,822
Net Effect	-149	-196	-485	-$838	-$2,987	-$10,995

Shown in Table 6 is a summary of the net effects on local employment and employee and proprietor income resulting from the in-Delta storage project.

Chapter 2
ECONOMIC BENEFIT AND COST ANALYSIS

2.1 General

Economic Analysis is based on evaluation of Equivalent Annual Cost of project implementation including costs of project development, construction, mitigation and operation and maintenance, and the benefits as a result of increased project exports, operational flexibility, CVPIA(b)(2), Environmental Water Account and potential for water transfers.

Table 7

REGULATORY COSTS

Alternative	Mitigation, Monitoring & Regulatory Costs
Re-Engineered Delta Wetlands	$21,000,000
Bacon Island and Victoria Island with connection to Clifton Court	$21,000,000
Webb Tract and Victoria Island with connection to Clifton Court	$21,000,000

Unit water supply costs simply compares the equivalent annual project cost to the average annual water supply benefit on a dollars per acre-foot basis. This assessment should not be construed as the "cost per acre-foot of water supply." Instead, this economic evaluation should be considered one of many feasibility indicators that must be taken into consideration for project screening.

To estimate the urban and agricultural water supply economic benefits two models were used. An urban economic evaluation was performed using the Least-Cost Planning Simulation Model (LCPSIM) while the agricultural evaluation was preformed using the Central Valley Planning Model (CVPM). The economic assumptions, evaluation methodologies, and study results are discussed below.

2.2 Project Costs

Project costs were developed for each alternative. These costs include regulatory costs, capital costs and O&M costs.

2.2.1 Regulatory Costs

Regulatory costs reflect documentation, permitting and initial monitoring and mitigation expenses. Estimated initial environmental mitigation and monitoring costs are given in Table 7.

2.2.2 Forgone Investment Value

The Foregone Investment Value was calculated based on the construction estimate, engineering and regulatory costs. The Forgone Investment Value sometimes referred to as Interest During Construction, is typically considered in estimating the total capital cost of a proposed project. Throughout the construction period, funds are withdrawn from the economy to support the construction process. These allocated funds are therefore not available during the construction period for alternative investment opportunities that would provide net economic returns. A discount rate of 6 percent was assumed for this adjustment.

A construction period of five years was assumed for the project. For Cost Allocation purposes, cost of proposed storage facilities construction is assumed as follows.

Year 1: Land Acquisition Cost plus 15% Conveyance Facilities and Levee Improvements Costs
Year 2: 20% Conveyance Facilities and Levee Improvement Costs
Year 3: 25% Conveyance Facilities and Levee Improvement Costs
Year 4: 20% Conveyance Facilities and Levee Improvement Costs
Year 5: 20% Conveyance Facilities and Levee Improvement Costs

Forgone Investment Values are shown below in Table 8.

2.2.3 Project Capital Cost

Project Capital Cost includes the following.

Table 8
FORGONE INVESTMENT VALUE ADJUSTMENT
(Millions of 2001 Dollars)

Alternative	Type of Facility	Project Total Construction Costs	Years to Construct	Adjustment (Year 4)	Adjustment (Year 3)	Adjustment (Year 2)	Adjustment (Year 1)	Adjustment (Year 0)	Total Adjustment
Re-Engineered Delta Wetlands	R	423.9	5	32.4	16.2	13.1	5.1	--	66.8
Bacon and Victoria Island with connection to Clifton Court	R	510.2	5	37.2	19.5	15.8	6.1	--	78.5
Webb Tract and Victoria Island with connection to Clifton Court	R	501.3	5	36.7	19.1	15.5	6.0	--	77.4

- Total Construction Cost including engineering design, legal and construction
- Forgone Investment Value

Project Capital Cost including the Construction Cost, Regulatory Cost and Foregone Investment Values are given in Table No. 1.

2.2.4 Annual Cost

The annual cost is the sum of the three elements: (1) the capital recovery cost, (2) property tax loss in-lieu property tax payments for loss of agriculture, and (3) the recurring annual costs. The first element includes the amortized total capital cost. The second element includes the loss of revenues due to loss of agricultural lands and in-lieu payment. The third element includes operation and maintenance costs as well as energy costs incurred for the project operations.

- Capital Recovery - Annualized capital costs were developed for each of the proposed projects. This is based on the total capital costs amortized over a fifty-year period with an assumed discount rate of 6 percent.
- In-lieu property tax payments
- Recurring Annual Operation and Maintenance Costs: These costs include the following items.
  - Levee maintenance
  - Intake and Outlet structures maintenance including pumping stations, gate units, siphons and fish screens for both, reservoir and habitat islands.
  - Pumping Energy costs
  - Seepage control systems maintenance and monitoring
  - Water quality monitoring, and
  - Environmental monitoring including wildlife and habitat monitoring.

Annual Cost of Development for in-Delta storage alternatives is also given in Table 1.

2.3 Assessment of Project Benefits

2.3.1 General

In-Delta storage benefits to be included in economic evaluation are:

- Additional SWP/CVP System Exports for urban and agricultural use
- Contribution to meet CVPIA Requirements including South of Delta Refuges
- Additional Joint Point Diversion Benefits
- Environmental Water Account
- Banking for Water Transfers
- Recreational Benefits

2.3.2 Urban and Agricultural Water Supply Benefits

To estimate the urban and agricultural water supply economic benefits two models were used. An urban economic evaluation was performed using the DWR's Least-Cost Planning Simulation Model (LCPSIM) while the agricultural benefits were evaluated with the Central Valley Planning Model (CVPM).

2.3.2.1 Urban Benefits

The following assumptions and analysis criteria were important to the urban benefits analysis:

- Benefits in relation to base deliveries include 2020 impacts on shortage related costs and losses and on the economic justification for adding additional local reliability from the available water use efficiency options (e.g., water recycling). The benefits of any alternative are determined by the change in total avoided costs and losses: shortage-related and related to the use of local water use efficiency options.
- The conservation options used in LCPSIM are beyond those expected to be implemented by 2020 under the urban Best Management Practices MOU.
- Regionally, the San Francisco Bay Region is expected to be at a relatively high level of reliability in 2020 after the assumed adoption of economically justified local water conservation and supply augmentation measures in the context of the assumed availability of local carryover storage. Consequently, SWP deliveries available under contract and interruptible deliveries that were not of net economic value to the region (hereafter referred to as unallocated deliveries) were assumed to be available to augment SWP South Coast Region urban deliveries.
- Because of the level of local reliability that will be justified in 2020 within the region and the assumed availability of local carryover storage, the unallocated San Francisco Bay Region deliveries, SWP supplies available under contract, and interruptible supplies not of net economic value to the South

Coast Region were assumed to augment SWP agricultural deliveries. The incremental unallocated deliveries produced by the project were assumed to augment CVP agricultural deliveries.

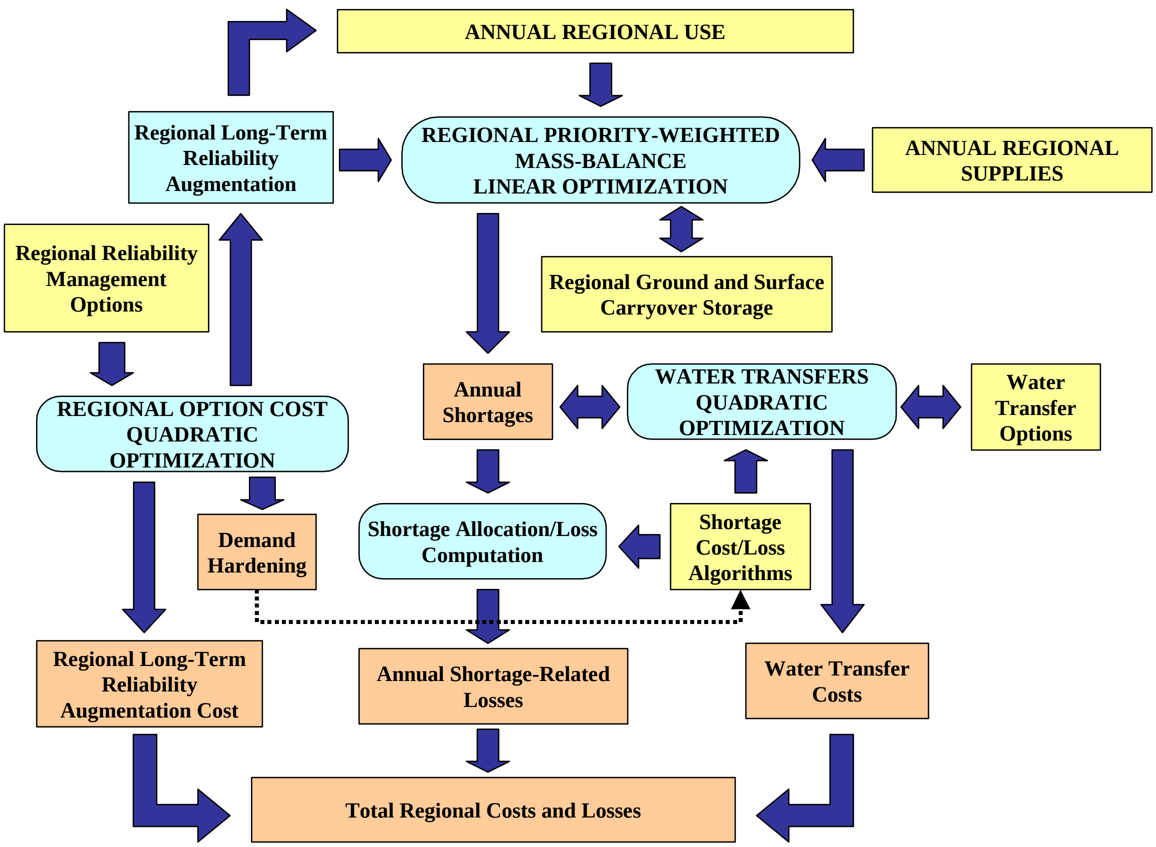
- Supplies available to, but not delivered for SWP urban use generated by in-Delta storage can be retained for CVPIA refuges water or can be credited to CVP for agricultural uses. For this study, the deliveries were credited to CVP agricultural users. This logic is meant to model one potential outcome of market based future water allocation negotiations between urban and agricultural users (in this case, an unconstrained “free-market” bookend.)
- Although the implementation of urban water conservation measures reduce the frequency and magnitude of shortages, demand hardening effects are assumed to cause an increase in economic losses when water shortages do occur. Since the already implemented conservation measures (assumed to be less costly than the remaining conservation options) are no longer available for shortage management, the value of new supply is therefore increased during shortage events.
- Reliability benefits for the Central Coast Region, an area not covered by the LCPSIM model, was interpolated from the results produced by LCPSIM for the San Francisco Bay Region.
- Benefits of in-Delta storage to urban users of SWP supplies in the San Joaquin Valley were based on the cost of existing local groundwater operations.

2.3.2.1.1 Urban Reliability Benefits Analysis with LCPSIM

The Least-Cost Planning Simulation Model has been developed to assess the economic benefits and costs of increasing water service reliability to urban areas by evaluating the economic consequences of the yearly changes in demands and availability of water supplies. LCPSIM measures water service reliability benefits by estimating the ability of shortage management (contingency) measures to mitigate regional costs and losses associated with a shortage. Assumptions about the effectiveness of regional long-term and shortage contingency options that can be employed to enhance reliability are incorporated into LCPSIM along with estimates of their costs. One of the primary objectives of LCPSIM is to develop an "economically efficient" regional water management plan.

In LCPSIM, a priority-based objective, mass balance-constrained linear programming solution is used to simulate regional water management operations on a yearly time-step, including the operation of surface and groundwater carryover storage capacity assumed to be available to the region. Economic losses due to shortage events are based on a residential water user loss function. The cost of adding regional long-term water management measures is determined using a quadratic-programming algorithm. Quadratic programming is also used to simulate water market purchases during shortage events, solving for the least-cost combination of shortage-related economic losses and the cost of transferred water. Demand

Figure 1
LCPSIM Logic



hardening—the increase in the size of the economic losses associated with specific shortage events—is related to the level of use of regional long-term conservation measures. The least-cost combination of economic risk, regional long-term water management facilities and programs, and contingency water transfers is identified within the model for each alternative water management plan being evaluated. Figure 1 shows the major model logic flows. Figure 2 provides the details of the inputs.

Figure 2
LCPSIM Data and Parameters

REGIONAL RELIABILITY MANAGEMENT OPTIONS
Conservation/Recycling/Desalting By Source:
- **Cost Function Specification**
  - Fixed Costs
    - Base [f(0 TAF)]
    - Incremental Cost of Capacity [f′]
  - Peaking Operations Costs
- **Total Quantity Available**
- **Effect on Annual Water Balance**
  - Supply Increase
  - Use Reduction
- **Associated Costs & Constraints**
  - Conveyance (Incl. System Losses)
  - Treatment & Distribution

REGIONAL GROUND AND SURFACE CARRYOVER STORAGE
By Storage Facility:
- **Operational Priorities**
- **Carryover Capacity**
- **Initial Fill**
- **Put & Take Costs & Constraints**
  - Injection/Spreading/Pumpback
  - Conveyance (Incl. System Losses)
  - Treatment & Distribution
- **Hedging**
  - Call/Storage Factor
  - Storage/Capacity Factor

ANNUAL REGIONAL USE
- **Average BMP-Adjusted Use**
  - Average Use
  - Expected Effect of BMPs
- **Climate-Related Variation**

SHORTAGE ALGORITHMS
- **Shortage Management Campaign**
  - Cost
  - Maximum Expected Use Reduction/ Transfer Market/Interruptible Program Threshold
- **Shortage Allocation Rule**
  - % Of Residential Shortage Allocated to Commercial Users After Threshold
  - % Of Residential Shortage Allocated to Industrial Users After Threshold
- **Proximate Shortage Adjustment**
  - Threshold
  - Adjustment Factor
  - Time Limit
- **Interruptible Deliveries**
  - Quantity
  - Shortage Reduction Schedule
  - Value
- **Loss Function Specification**
  - Intercept [f(0% Deficiency)]
  - Incremental Cost of Shortage [f′]
  - Change in Incremental Cost [f″]
- **Demand Hardening Factor**
- **Rationing**
  - Threshold
  - Management Cost
- **Peaking Option Management**
  - Current Year Deficiency Only
  - Optional General Supply Source

ANNUAL REGIONAL SUPPLIES
Imported:
- **CALSIM Operations Studies**
  - SWP Deliveries
  - CVP Deliveries
- **Regional Operations Studies**
  - LA Aqueduct
  - Colorado River Aqueduct
  - Hetch-Hetchy Aqueduct
  - Mokelumne Aqueduct

Within Region:
- **Avg. Surface**
- **Avg. Groundwater**
- **Recycling**

Associated Costs & Constraints
- Conveyance (Incl. System Losses)
- Treatment & Distribution

TRANSFER OPTIONS
By Source Type:
- **Market Price**
- **Total Quantity Available**
  - Sequential Year Constraints
  - Cumulative Constraints
- **Associated Costs & Constraints**
  - Conveyance (Incl. System Losses)
  - Treatment and Distribution

LCPSIM takes a comprehensive view of water supply reliability, incorporating key information on the frequency, size, and impacts of shortages. Regional water managers and users must respond primarily to actual year-to-year fluctuations in demand level and water supply availability rather than to average levels of demand and supply. As shortages increase in magnitude and regularity, shortage management becomes increasingly important. LCPSIM evaluates the economic justification of the level of reliability enhancement provided by any combination of long-term water management options in the context of regionally available contingency options. Regional water management options are divided into three categories: (1) shortage contingency demand management and supply augmentation; (2) long-term demand management and supply enhancement; and (3) economic risk management. The latter accepts a known degree of economic risk from shortages in order to avoid the use of other water management options that are perceived to be even more costly.

Depicted in Figure 3 is an analysis of the benefits of in-Delta storage for the South Coast Region. The lower curve represents the cumulative capital and OM&R cost of adding additional local long-term reliability. The upper two sets of curves represent the shortage-related losses (includes shortage-relates costs) and total costs (the sum of losses and the cost of adding local long-term reliability. The first set represents the without project condition (the curves which start at the same point at left in the uppermost position.) The second set (starting somewhat lower at left) represents the with project condition. As can be seen, while the losses drop as local reliability increases, the total cost increases after an initial drop for both sets of curves.

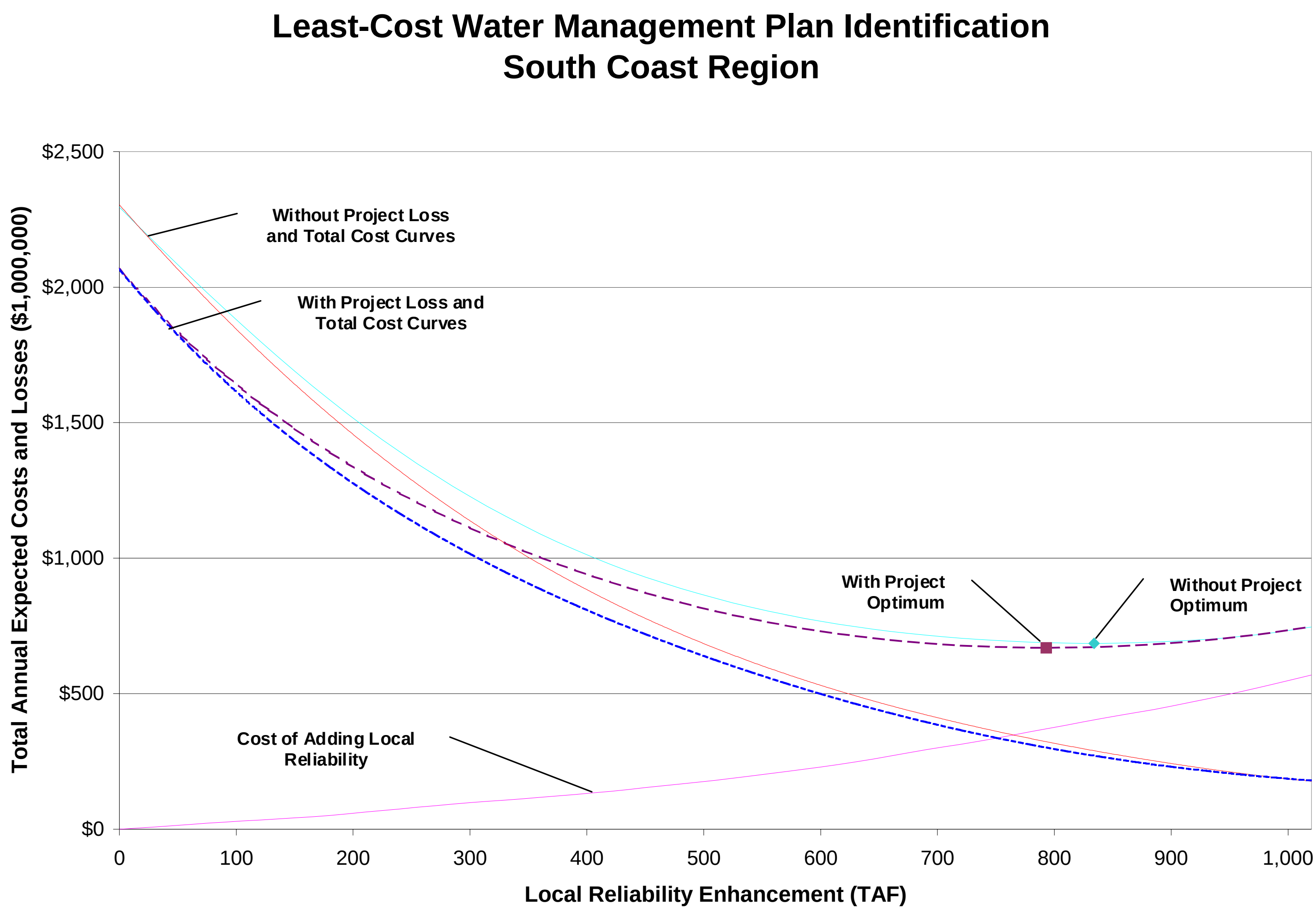
The lowest points on the total cost curves are identified by the diamond for the without project condition and the square for the with project condition. These points represent the economically efficient (least-cost) management plans for each condition. The benefit of the project is the amount by which the least-cost plan for the with project condition is lower (less expected total costs and losses) than the least-cost plan for the without project condition.

The following LCPSIM assumptions should be noted:

Economic benefits are computed at specifically identified demand levels (e.g., Year 2020 level) only. This conforms the model to CALSIM hydrologic output which is generated for specific study year levels, which are tied to fixed levels of demand and upstream depletions, rather than over a period of time. Because the economic life of the alternatives to be evaluated can be up to fifty years, benefit estimation will be biased if only a single study year level is used. Currently, because the most-distant DWRSIM study year is 2020, the results can be biased due to expected increases in urban demand beyond the year 2020. Conversely, if studies at less distant times (e.g., Year 2005) are not made, a project may be brought on line before it is economically justified to do so.

Regional water supply sources that are not modeled on a year-to-year basis in the LCPSIM are assumed to be continually at their average year values. This simplifying assumption can bias the results by not capturing the large costs and losses which can arise when shortages occur on these regional supplies and the explicitly modeled imported supply systems concurrently. This bias is most likely to be present when the regional area has limited carryover storage capacity compared to the size of current-year use. Similarly, the benefits of the coincidence of "surpluses" on both systems is not correctly taken into account, although this bias is reduced in areas with limited carryover storage capacity. Both situations will tend to show less benefits from increased reliability than would otherwise be the case.

Figure 3.
LCPSIM Optimization Example



The determination of reliability benefits is done in the LCPSIM on the basis of a risk-neutral view of risk management. Risk-averse management (risk minimization) by regional agencies--which has been the predominant mode--would result in the justification of more costly water management options than under the risk-neutral assumption.

The LCPSIM assumes that the regions being evaluated have the facilities and institutional agreements in place to move water as needed to minimize the impact of shortages. Because this is more or less unlikely to be the situation, the model may undervalue the benefits of additional CVP/SWP supplies for this reason. This is problematic, however, because of the interaction between local reliability, the assumed availability of local carryover storage, the economically justified level of adoption of local constant yield reliability management options, and the timing of the availability of the CVP/SWP supplies. Assuming a reduced ability of the region to mitigate shortages with intra-regional water transfers may result in assigning a higher value to the CVP/SWP supplies taken, for example, but the amount of those supplies actually useable because of their timing may be reduced (i.e., the CVP/SWP source is relegated to more of a peaking supply.)

The urban demand numbers used in the LCPSIM are not changed in response to the higher urban user water costs which can be anticipated as regional agencies add to their supply reliability by developing regional supplies or paying for Statewide supply options. The demand numbers used are taken from Bulletin 160-98 and reflect the extensive adoption of Urban Best Management Practices. The adoption of these BMP's significantly reduces flexibility of users to respond to price (see the discussion of "demand hardening" above) and it can be reasonably assumed that at least part of the reason for their adoption is pricing incentives. For these reasons, putting a price elasticity of demand factor on top of these assumptions would constitute double counting and would be likely to seriously overstate the effect of water price increases. To the extent that this double counting does not occur, the model would overestimate the value of adding reliability enhancement options.

The LCPSIM model was run for both the San Francisco Bay Region and the South Coast Region. Demands were based on the 2020-level values developed for DWR Bulletin 160-98 and include the forecasted levels of adoption of best management practices (BMPs) for urban conservation. The residential user loss function was assumed to be the same for both regions. Shown in Table 9 is the willingness to pay to avoid one-time shortages of specific sizes by residential customers with specified annual water use rates (use per year per household). Users in the commercial and industrial water use sectors–where, above a threshold shortage size, marginal losses were assumed to be higher–were allocated proportionately less of the overall shortage during shortage events by the LCPSIM logic in order to allow the application of this loss function to the entire shortage.

Table 9.
LCPSIM Loss Function Values

	Willingness-to-pay/Event		
	AF Use/YR/HH		
Deficiency	0.75	0.65	0.55
0%	$0	$0	$0
5%	$49	$43	$36
10%	$145	$126	$106
15%	$278	$241	$204
20%	$439	$380	$322
25%	$618	$535	$453
30%	$804	$697	$590
35%	$990	$858	$726

Table 10.
South Coast Region Carryover Storage Capacities

Operation	Capacity(TAF)	Init. Fill	Rech. Eff.	Put Limit(TAF)	Put Cost	Take Limit(TAF)	Take Cost	Shared Cap.	Type	Put Prty	Take Prty	Description
1	225	100%	100%	225	$0	225	$0	1	1	1	6	Terminal Reservoirs
2	660	50%	100%	200	$0	660	$0	2	1	5	1	Local Reservoir Augmentation (Int)
3	1,500	50%	100%	30	$0	500	$75	3	2	6	2	Local GW In-Lieu Recharge (Int)
4	1,500	50%	95%	375	$20	500	$75	3	1	6	3	Local GW Spreading Recharge (Int)
5	660	50%	100%	660	$0	660	$0	2	1	2	1	Local Reservoir Augmentation
6	210	50%	95%	55	$90	70	$85	4	1	3	5	Local Banking
7	550	50%	95%	200	$90	120	$85	5	3	4	4	External Banking

Carryover storage capacity allows a current year supply, which is in excess of current year use to be held over to meet use during years with supply deficiencies. Carryover storage capacity can exist in surface reservoirs or in groundwater basins. The operation of groundwater capacity is generally less effective for shortage management because annual refill (put) and extraction (take) rates can be relatively limited compared to reservoir storage capacity. Shown in Table 10 are the carryover storage assumptions used for the South Coast Region.

The capacities listed are not additive for the South Coast Region because Operations 2 and 5 share the same surface reservoir storage capacity. Similarly, Operations 3 and 4 share the same groundwater storage capacity. The operations are separately identified in the model to allow for differences in refill and use operations in terms of priority, cost, or rate. Operation 1, terminal reservoir storage, is also identified separately because of differences in priority of refill and use compared to other surface reservoir storage.

Table 11.
San Francisco Bay Area Carryover Storage Capacities

Operation	Capacity(TAF)	Init. Fill	Rech. Eff.	Put Limit(TAF)	Put Cost	Take Limit(TAF)	Take Cost	Description
1	100	50%	100%	100	$0	100	$0	Local Reservoir Storage
2	100	50%	95%	100	$15	20	$16	Local GW Spreading
3	443	50%	95%	70	$90	70	$85	External Banking

Shown in Table 11 are the carryover storage capacity assumptions for the San Francisco Bay Region. This capacity includes recent agreements for banking water in the Tulare Lake Basin patterned after the agreement made for the South Coast Region (Option 7, above).

Shortage contingency water transfers were assumed to be available for both regions. The maximum annual level of contingency transfers assumed to be available from the San Joaquin Valley was 400 taf for the South Coast Region and 100 taf for the San Francisco Bay Region, the amounts assumed to be available through the State Drought Water Bank and other transfer options. Transfer option were assumed to cost about $175/af, excluding conveyance (specified conveyance costs are added within LCPSIM) .

Each transfer was constrained not to occur over 25% of the time unless the quantity transferred was less than the maximum annual amount available (i.e., 250% of the maximum annual amount in any ten year period). If less than the maximum available was transferred, the frequency could be proportionately higher. The quantity transferred during any two consecutive years also could exceed the maximum annual amount available. These constraints apply independently to each transfer source identified. In addition, transfers could only be used when the available regional supplies were below 93 % of current consumptive demand. Up to a 7% shortage was assumed to be relatively easily managed with a contingency conservation program which the model assumes would be triggered by a shortage of this size.

The Central Valley agricultural water transfers resulting from the LCPSIM runs were used to reduce the surface supplies available to SWP and CVP contractors in the CVPM agricultural production model for those years that the transfers occurred. A 50% allocation of the transferred amount to each project was assumed. The income from these transfers was included in the agricultural benefits analysis.

Long-term demand management options that are adopted by water users can have a demand “hardening” effect. Although they can increase reliability by reducing the size, frequency and duration of shortage events, they can make these events relatively more costly when they do occur. This occurs because these options tend to reduce the “slack” in the system (i.e., reduce or eliminate the least valuable water uses and/or the least efficient water use methods). This means that things are already "closer to the bone" for users and they are more vulnerable when shortages happen. For LCPSIM runs, the hardening factor was assumed to be 50% (i.e., if conservation decreases demand by 10% then the

Table 12.
South Coast Region Options

Source	Amount Avail (TAF)	Cost (Fixed) ($/AF)	Cost (Variable) ($/TAF)	Source (Type)	Description (AlphaNumeric)
1	67	$750	$0.00	2	Conservation I (New Dev. - Outdoor)
2	110	$400	$0.00	2	Conservation II (Indoor - 60GPCD)
3	110	$800	$0.00	2	Conservation II (Indoor - 55GPCD)
4	30	$500	$0.00	2	Conservation III (3% Non-Resid. Use)
5	18	$1,167	$0.00	2	Conservation III (5% Non-Resid. Use)
6	84	$300	$0.00	3	Conservation IV (System Loss @ 5%)
7	93	$395	$3.20	1	Groundwater Recovery I
8	2	$890	$0.00	1	Groundwater Recovery II
9	4	$179	$0.00	1	Water Recycling I
10	236	$236	$0.70	1	Water Recycling II
11	226	$433	$2.40	1	Water Recycling III
12	13	$1,180	$0.00	1	Water Recycling IV
13	5	$2,147	$165.00	1	Water Recycling V
14	5	$920	$0.00	1	Ocean Water Desalting I
15	100	$1,030	$0.00	1	Ocean Water Desalting II
16	900	$1,700	$0.00	1	Ocean Water Desalting III

economic impact of a shortage of a specified size was computed as if the shortage was actually 5% greater.)

Table 12 is the option input table used for the South Coast Region. Information from DWR Bulletin 160-98 was used to develop the data in the table. The conservation options shown in this figure represent actions beyond those assumed to have been implemented to achieve the level of conservation already incorporated in the study demands due to the adoption of best management practices.

One difference in the assumptions on available options for the South Coast Region was that the Bulletin assumed that diversions from the Colorado River Aqueduct were held at 550 taf in the base case.

Table 13.
San Francisco Bay Region Options

Source	Amount Avail (TAF)	Cost (Fixed) ($/AF)	Cost (Variable) ($/TAF)	Source (Type)	Description (AlphaNumeric)
1	2	$750	$0.00	2	Conservation I (New Dev. - Outdoor)
2	38	$400	$0.00	2	Conservation II (Indoor - 60GPCD)
3	38	$800	$0.00	2	Conservation II (Indoor - 55GPCD)
4	11	$500	$0.00	2	Conservation III (3% Non-Resid. Use)
5	7	$1,167	$0.00	2	Conservation III (5% Non-Resid. Use)
6	13	$300	$0.00	3	Conservation IV (System Loss @ 5%)
7	9	$510	$0.00	1	Groundwater Recovery I
8	20	$95	$0.00	1	Water Recycling I
9	4	$243	$0.00	1	Water Recycling II
10	24	$563	$28.50	1	Water Recycling III
11	1	$2,381	$0.00	1	Water Recycling IV

Transfer, conservation, and land fallowing options for the Colorado River Region to augment this supply were developed for the Bulletin. For the purposes of the current LCPSIM study, the amount of water assumed to be imported through the Colorado River Aqueduct was assumed to be held at a constant 1.1 MAF (92% of capacity) to account for plans by the Metropolitan Water District and the San Diego County Water Authority plans for imports in the future. Consequently, no options were included which involved additional water being wheeled through the aqueduct since it is essentially at capacity under this assumption.

Table 13 is the option input table used for the San Francisco Bay Region which was also developed from information used in Bulletin 160-98.

Price elasticity of water demand was considered in two ways, the economic optimization logic used in LCPSIM depends on comparing the marginal cost of additional regional conservation to the marginal cost of additional regional supply and the marginal expected cost of shortages. Demand is therefore a function of the overall regional economic efficiency of water management in light of the CALFED alternative being evaluated.

The effect of the with project case was evaluated with LCPSIM by running the model with the CVP/SWP deliveries expected under the base case to obtain the least-cost combination of shortage-related costs and losses (including shortage management costs) and the investment and operations costs of long-term water management options (i.e., the least-cost solution). The model was then run with the change in deliveries expected with the project in place. The least-cost solution for each Program Alternative were then compared to the original results.

Because the increased CVP/SWP deliveries, particularly during dry and critical years, LCPSIM achieved a least-cost solution with lower total costs (i.e., a superior least-cost solution) with the project in place. This was achieved either by a reduction in expected shortage-related costs and losses or by avoiding the costs associated with long-term water management options no longer needed to achieve the least-cost solution, or both. It should be noted that some superior least-cost solutions can result in higher shortage-related costs and losses or higher costs associated with long-term water management options but the net effect is a lower total cost. For this study, the superior solution for the South Coast Region included higher shortage-related costs and losses offset by an even greater reduction in costs associated with long-term water management options. The superior solution for the San Francisco Region included both lower
shortage-related costs and losses and a reduction in costs associated with long-term water management options.

The SWP and CVP water deliveries used by LCPSIM are generated by the CALSIM project operations model. The model is driven by target delivery quantities, which it tries to meet based on available inflows and storage's on the SWP and CVP systems for each year of the 2020 level hydrology used. Because these targets are set independently of the LCPSIM model, the economically efficient (i.e., least-cost) water management plan for the South Coast or San Francisco Bay Region in the context of the assumed availability of local carryover storage produced a level of reliance on local supply and conservation options which resulted in the target deliveries having been set too high for the wetter years.

In-lieu of iterating the CALSIM model with revised target deliveries, the assumption was made that a reallocation of the "excess" supply to the San Francisco Bay Region would be made to the South Coast Region in the years which it was available. Subsequently, any remaining "excess" supply was reallocated to CVP agricultural contractors. This latter quantity was used to augment annual deliveries to San Joaquin CVP agricultural contractors in the CVPM agricultural production model. In this manner, the LCPSIM results were linked to the CVPM results through the urban to agricultural reallocation of deliveries during the wetter years and the agricultural to urban transfers during dry and critical years as discussed earlier.

Shown in Table 14 are the results of the LCPSIM runs for the San Francisco and South Coast Regions. The size of the expected shortage during a 90/91 event drops from about 15 percent for the without project condition to between 11 and 12 percent for the with project condition.

The costs and loss values shown in Table 14 and previous tables were based on 1999 level dollars. The Table 15 and Table 16 provide a summary of the results indexed to year 2001 level dollars.

Table 14
LCPSIM Output

Annual Values / Increment >	San Francisco Bay Region urban_delta_base	urban_delta_5000	South Coast Region urban_delta_base	urban_delta_5000
Avg. Incremental Avail. Supply (TAF)	0	0	0	90
Avg. Incremental Delta. Supply (TAF)	0	7	0	36
Avoided Loss/Cost ($1,000)	$0	$4,715	$0	$24,402
Total Loss/Cost ($1,000)	$124,033	$119,318	$592,786	$568,384
Shortage Loss/Cost ($1,000)	$87,203	$86,678	$256,204	$254,228
Regional Fixed Option Cost ($1,000)	$36,829	$32,639	$336,582	$314,157
Regional Fixed Option Use (TAF)	102	96	781	721
Marg. Fixed Option Cost ($/AF)	$800	$808	$800	$878
Drought Shortage (90/91)	14%	13%	8%	8%
Total Transfer Quantity (TAF)	520	518	617	594
Ann. Avg. Transfer Quantity (TAF)	7	7	8	8
Total Transfer Cost ($1,000)	$91,000	$90,650	$107,975	$103,950
Ann. Avg. Transfer Cost ($1,000)	$1,247	$1,242	$1,479	$1,424
Wet Year (21 years)				
Avg. Net Supply (TAF)	234	236	670	694
Avg. Regional Storage Use (TAF)	1	0	16	9
Avg. Quan. Transferred (TAF)	0	0	0	0
Avg. SWP Delivery Incr (TAF)	0	7	0	54
Avg. CVP Delivery Incr (TAF)	0	0	0	0
Avg. Adj. User Shortage (TAF)	0	0	0	0
Avg. Shortage Losses ($1,000)	$0	$0	$0	$0
Avg. Cost of Transfers ($1,000)	$0	$0	$0	$0
Above Normal Year (10 years)				
Avg. Net Supply (TAF)	107	108	320	363
Avg. Regional Storage Use (TAF)	0	0	0	0
Avg. Quan. Transferred (TAF)	0	0	0	0
Avg. SWP Delivery Incr (TAF)	0	7	0	73
Avg. CVP Delivery Incr (TAF)	0	0	0	0
Avg. Adj. User Shortage (TAF)	0	0	0	0
Avg. Shortage Losses ($1,000)	$0	$0	$0	$0
Avg. Cost of Transfers ($1,000)	$0	$0	$0	$0
Below Normal Year (14 years)				
Avg. Net Supply (TAF)	64	69	188	200
Avg. Regional Storage Use (TAF)	19	20	77	74
Avg. Quan. Transferred (TAF)	0	0	0	0
Avg. SWP Delivery Incr (TAF)	0	10	0	72
Avg. CVP Delivery Incr (TAF)	0	0	0	0
Avg. Adj. User Shortage (TAF)	0	0	69	72
Avg. Shortage Losses ($1,000)	$0	$0	$112,872	$124,150
Avg. Cost of Transfers ($1,000)	$0	$0	$0	$0
Dry Year (15 years)				
Avg. Net Supply (TAF)	-64	-61	-429	-396
Avg. Regional Storage Use (TAF)	35	37	250	246
Avg. Quan. Transferred (TAF)	3	3	8	8
Avg. SWP Delivery Incr (TAF)	0	10	0	73
Avg. CVP Delivery Incr (TAF)	0	0	0	0
Avg. Adj. User Shortage (TAF)	46	42	252	225
Avg. Shortage Losses ($1,000)	$116,032	$103,040	$455,565	$400,983
Avg. Cost of Transfers ($1,000)	$580	$547	$1,323	$1,094
Critical Year (12 years)				
Avg. Net Supply (TAF)	-255	-257	-912	-914
Avg. Regional Storage Use (TAF)	98	97	480	473
Avg. Quan. Transferred (TAF)	29	29	41	41
Avg. SWP Delivery Incr (TAF)	0	4	0	26
Avg. CVP Delivery Incr (TAF)	0	0	0	0
Avg. Adj. User Shortage (TAF)	119	121	391	405
Avg. Shortage Losses ($1,000)	$373,111	$369,706	$919,884	$887,065
Avg. Cost of Transfers ($1,000)	$6,810	$6,826	$7,233	$7,204
Conservation I (New Dev. - Outdoor)				
Use (TAF)	2	0	67	67
Cost ($1,000)	$1,300	$0	$90,250	$90,250
Conservation II (Indoor - 60GPCD)				
Use (TAF)	36	36	110	110
Cost ($1,000)	$15,200	$15,200	$44,000	$44,000
Conservation II (Indoor - 55GPCD)				
Use (TAF)	1	0	16	0
Cost ($1,000)	$716	$0	$12,800	$0
Conservation III (3% Non-Resid. Use)				
Use (TAF)	11	11	30	30
Cost ($1,000)	$5,500	$5,500	$15,000	$15,000
Conservation IV (System Loss @ 5%)				
Use (TAF)	13	13	84	84
Cost ($1,000)	$3,900	$3,900	$25,200	$25,200
Groundwater Recovery I				
Use (TAF)	9	9	93	88
Cost ($1,000)	$4,590	$4,590	$50,873	$47,285
Water Recycling I				
Use (TAF)	20	20	4	4
Cost ($1,000)	$1,800	$1,800	$716	$716
Water Recycling II				
Use (TAF)	4	4	236	236
Cost ($1,000)	$972	$972	$75,190	$75,190
Water Recycling III				
Use (TAF)	4	1	111	102
Cost ($1,000)	$2,551	$877	$83,023	$88,506
San Joaquin Valley				
Number of Transfers	8	8	7	7
Quantity (TAF)	520	518	617	594
Cost ($1,000)	$91,000	$90,650	$107,975	$103,950
Avg. Quantity per Trf. (TAF)	65	65	88	85
Frequency	11%	11%	10%	10%

Table 15
Summary of Results for the San Francisco Bay Region (2001 $)

Regional Economic Benefits	**Value**
Avg Incremental Available Urban Supply (TAF)	8
Avg Incremental Unallocated Urban Supply (TAF)	1
Net Avg Incremental Delivered Urban Supply (TAF)	7
Avoided Costs/Losses ($1,000)	$4,922
Avg Value of Incremental Urban Supply ($/AF)	$699

Regional Water Management -- Least-Cost Planning Criterion		
	Without Project	**Change from Without Project (Costs/Losses are Annual Values)**
Expected Shortage-Related Costs/Losses ($1,000)	$91,040	-$548
Shortage Contingency Water Transfers		**Change from Without Project (Costs and Quantities are for the 73-Year study period)**
Number of Transfer Events	8	0
Total Quantity Transferred (TAF)	520	-2
Total Cost ($1,000)	$95,004	-$365
Avg Quantity per Transfer Event (TAF)	65	0
Water Supply/Water Use Efficiency Option Use		**Change from Without Project (Costs and Quantities are Annual Values)**
Conservation (TAF)	65	-3
Conservation Cost ($1,000)	$27,996	-$2,313
Groundwater Recovery (TAF)	9	0
Groundwater Recovery Cost ($1,000)	$4,792	$0
Recycling (TAF)	28	-3
Recycling Cost ($1,000)	$5,662	-$2,061
Seawater Desalting (TAF)	0	0
Seawater Desalting Cost ($1,000)	$0	$0
Total Option Use (TAF)	102	-6
Total Option Cost ($1,000)	$38,450	-$4,374

Table 16.
Summary of Results for the South Coast
Region (2001 $)

Regional Economic Benefits	Value
Avg Incremental Available Urban Supply (TAF)	60
Avg Incremental Unallocated Urban Supply (TAF)	24
Net Avg Incremental Delivered Urban Supply (TAF)	36
Avoided Costs/Losses ($1,000)	$25,475
Avg Value of Incremental Urban Supply ($/AF)	$709

Regional Water Management -- Least-Cost Planning Criterion		
	Without Project	**Change from Without Project (Costs/Losses are Annual Values)**
Expected Shortage-Related Costs/Losses ($1,000)	$267,508	-$2,094
Shortage Contingency Water Transfers		**Change from Without Project (Costs and Quantities are for the 73-Year study period)**
Number of Transfer Events	7	0
Total Quantity Transferred (TAF)	617	-23
Total Cost ($1,000)	$112,726	-$4,202
Avg Quantity per Transfer Event (TAF)	88	-3
Water Supply/Water Use Efficiency Option Use		**Change from Without Project (Costs and Quantities are Annual Values)**
Conservation (TAF)	307	-16
Conservation Cost ($1,000)	$153,520	-$13,154
Groundwater Recovery (TAF)	93	-5
Groundwater Recovery Cost ($1,000)	$52,799	-$3,422
Recycling (TAF)	351	-9
Recycling Cost ($1,000)	$145,042	-$6,804
Seawater Desalting (TAF)	0	0
Seawater Desalting Cost ($1,000)	$0	$0
Total Option Use (TAF)	751	-30
Total Option Cost ($1,000)	$351,360	-$23,381

2.3.2.1.2 Central Coast Region Urban Supply Benefits

Benefits to the central cost region were estimated to be about $700 per acre-foot based in the LCPSIM results developed for the San Francisco Region. It was also assumed that the ratio of available supply to delivered supply, about 88%, would also be applicable to the Central Coast Region. For this reason the 2 taf made available to the Central Coast Region was valued at $1,329,000 annually.

2.3.2.1.3 San Joaquin Valley Urban Supply Benefits

The unit cost of existing local groundwater conjunctive use operations was estimated to be about $140 per acre-foot (including capital recovery and operations) and the operations cost of delivery of the SWP supply was estimated to be about $30 per acre-foot. Both figures include the estimated cost delivered at the treatment plant. This cost difference, about $110 per acre-foot, represents a floor on the future value of the SWP supply to the local urban water users, given the assumption that, without the additional increment of SWP delivery, the local conjunctive use facilities would have to be expanded. To the extent that the existing facilities were the least costly to develop, this value is likely to be conservative.

2.3.2.2 Agricultural Benefits

The following assumptions and analysis criteria were important to the agricultural benefits analysis:

- Both short-run and long run responses to changes in water resource conditions will be evaluated. The purpose of the long-run analysis is to estimate average economic conditions after farmers have made long-term adjustments to changes in supply availability and economic conditions. The purpose of the short-run analysis is to estimate acreage, crop mix, and water use during above and below average hydrologic events, given farmers' best possible responses to the temporary situation.
- The potential sources for agricultural in each region are identified as CVP water service contract supply, CVP water rights and exchange supply, State Water Project (SWP) supply, local surface supply, and groundwater.
- In the base case (i.e., no action alternative), unallocated interruptible and unallocated contract SWP urban deliveries are allocated to San Joaquin Valley SWP and CVP agricultural contractors in proportion to their deliveries under their respective contracts.
- The additional unallocated interruptible and unallocated contract SWP urban deliveries produced by the project are used to augment CVP agricultural deliveries.
- To reflect the reasonable (and conservative) assumption that planted acreage would not be based on interruptible deliveries because of planting decision constraints, planted acreages are held to the amounts which resulted from the evaluation of contract deliveries. In this manner, only reductions in local agricultural ground water pumping costs due to the in-lieu surface supply would be the benefit of the interruptible deliveries.

2.3.2.2.1 Agricultural Reliability Benefits Analysis with CVPM

Increased imported surface water supply reliability for agriculture generates increased benefits from the ability of farmers to increase their planted acreage and/or reduce more costly groundwater pumping. The timing of the supply as well as its quantity is important. In dry and critical years, when local surface supplies become less available, the increased availability of imported supplies can allow crops to be planted that would otherwise not have been planted, mitigating farm income impacts. In wetter years, the increased availability of imported supplies can reduce groundwater pumping costs (and help groundwater basins recover through in-lieu recharge.)

(The text immediately below was adapted from the US Bureau of Reclamation (Reclamation) Central Valley Improvement Act Draft PEIS, September 1997. Figure 4 and Table 17 and Table 18 are also from that document.)

The Central Valley Production Model (CVPM) is a regional model of irrigated agricultural production and economics that simulates the decisions of agricultural producers (farmers) in the Central Valley of California. The model assumes that farmers maximize profit subject to resource, technical, and market constraints. Farmers sell and buy in competitive markets, and no one farmer can affect or control the price of any commodity. To obtain a market solution, the model's objective function maximizes the sum of producers' surplus (net income) and consumers' surplus (net value of the agricultural products to consumers) subject to the following relationships and restrictions:

(1) Linear, increasing marginal cost functions estimated using the technique of positive mathematical programming. These functions incorporate acreage response elasticities that relate changes in crop acreage to changes in expected returns and other information.

(2) Commodity demand functions that relate market price to the total quantity produced.

(3) Irrigation technology tradeoff functions that describe the tradeoff between applied water and irrigation technology.

(4) A variety of constraints involving land and water availability and other legal, physical, and economic limitations.

The model selects those crops, water supplies, and irrigation technology that maximize profit subject to these equations and constraints. Profit is revenue minus costs. From (1) above, cost per acre increases as production increases. Revenue is irrigated acreage, times crop yield per acre, times crop price. From (2) above, crop price and revenue per acre decline as production increases. Relation (3) affects costs and water use through the selection of the least-cost irrigation technology. Relation (4) ensures that the model incorporates real-world hydrologic, economic, technical, and institutional constraints. The model includes 22 crop production regions in the Central Valley and 26 categories of crops. A map of the regions appears as Figure 4. Descriptions of each of the regions and crop types are provided in Tables 17 and 18, respectively.

Figure 4.
Areas Covered by CVPM

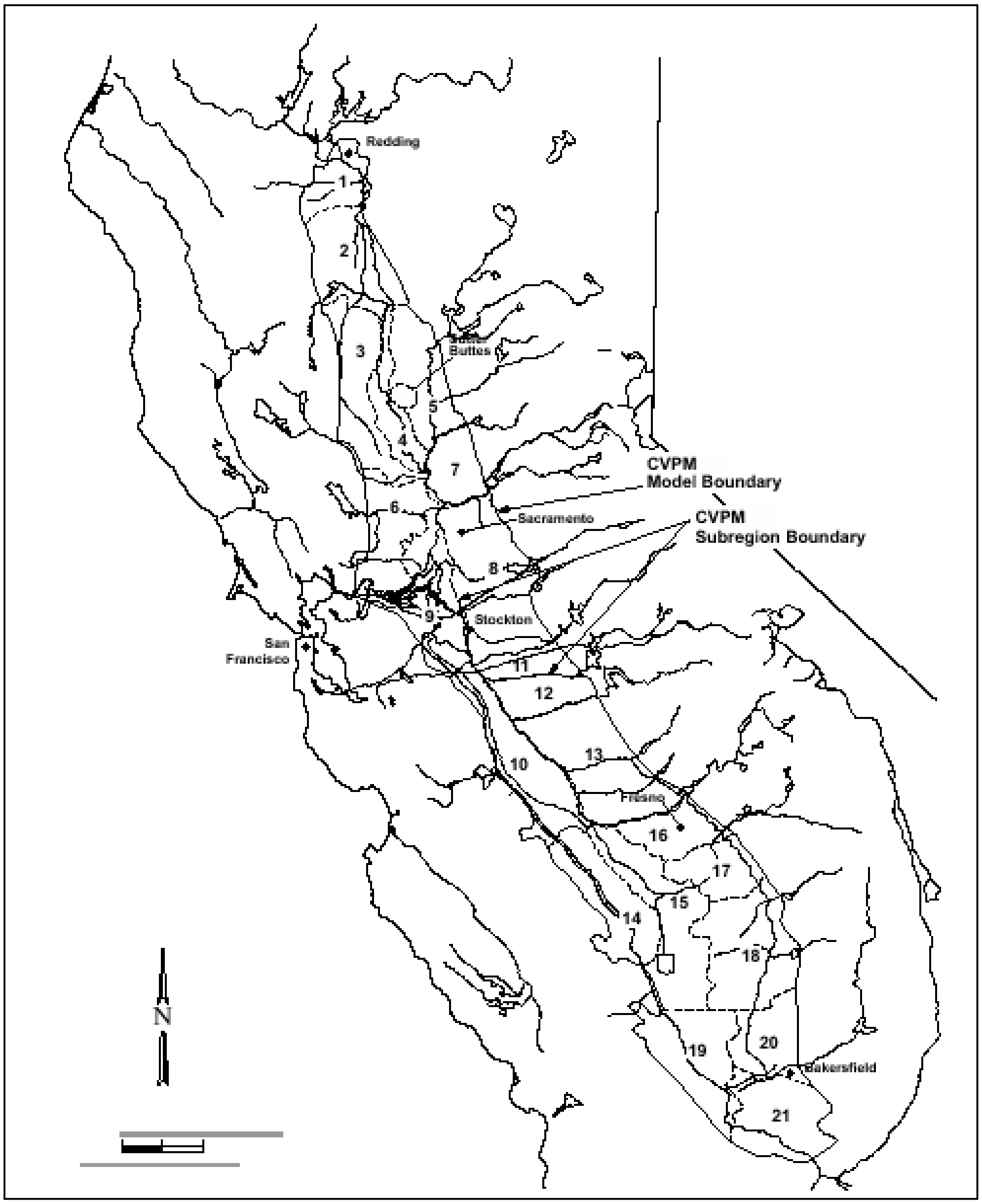


Table 17.
Water Districts Covered by CVPM

CVPM REGIONS AND DESCRIPTIONS

CVPM Region	Description of Major Water Users
1	CVP Users: Anderson Cottonwood, Clear Creek, Bella Vista, Sacramento River miscellaneous users.
2	CVP Users: Corning Canal, Kirkwood, Tehama, Sacramento River miscellaneous users.
3	CVP Users: Glenn Colusa ID, Provident, Princeton-Codora, Maxwell, and Colusa Basin Drain MWC.
3b	Tehama Colusa Canal Service Area. CVP Users: Orland-Artois WD, most of County of Colusa, Davis, Dunnigan, Glide, Kanawha, La Grande, Westside WD.
4	CVP Users: Princeton-Codora-Glenn, Colusa Irrigation Co., Meridian Farm WC, Pelger Mutual WC, Recl. Dist. 1004, Recl. Dist. 108, Roberts Ditch, Sartain M.D., Sutter MWC, Swinford Tract IC, Tisdale Irrigation, Sac River miscellaneous users.
5	Most Feather River Region riparian and appropriative users.
7	Sacramento Co. north of American River. CVP Users: Natomas Central MWC, Sac River miscellaneous users, Pleasant Grove-Verona, San Juan Suburban.
6	Yolo, Solano Counties. CVP Users: Conaway Ranch, Sac River Miscellaneous users.
9	Delta Regions. CVP Users: Banta Carbona, West Side, Plainview.
8	Sacramento Co. south of American River, San Joaquin Co.
10	Delta Mendota Canal. CVP Users: Panoche, Pacheco, Del Puerto, Hospital, Sunflower, West Stanislaus, Mustang, Orestimba, Patterson, Foothill, San Luis WD, Broadview, Eagle Field, Mercy Springs, Pool Exchange Contractors, Schedule II water rights, more.
11	Stanislaus River water rights: Modesto ID, Oakdale ID, South San Joaquin ID.
12	Turlock ID.
13	Merced ID. CVP Users: Madera, Chowchilla, Gravely Ford.
14	CVP Users: Westlands WD.
15	Tulare Lake Bed. CVP Users: Fresno Slough, James, Tranquillity, Traction Ranch, Laguna, Real. Dist. 1606.
16	Eastern Fresno Co. CVP Users: Friant-Kern Canal. Fresno ID, Garfield, International.
17	CVP Users: Friant-Kern Canal. Hills Valley, Tri-Valley Orange Cove.
18	CVP Users: Friant-Kern Canal, County of Fresno, Lower Tule River ID, Pixley ID, portion of Rag Gulch, Ducor, County of Tulare, most of Delano Earlimart, Exeter, Ivanhoe, Lewis Cr., Lindmore, Lindsay-Strathmore, Porterville, Sausalito, Stone Corral, Tea Pot Dome, Terra Bella, Tulare.
19	Kern Co. SWP Service Area.
20	CVP Users: Friant-Kern Canal. Shafter-Wasco, S. San Joaquin.
21	CVP Users: Cross Valley Canal, Friant-Kern Canal. Arvin Edison.

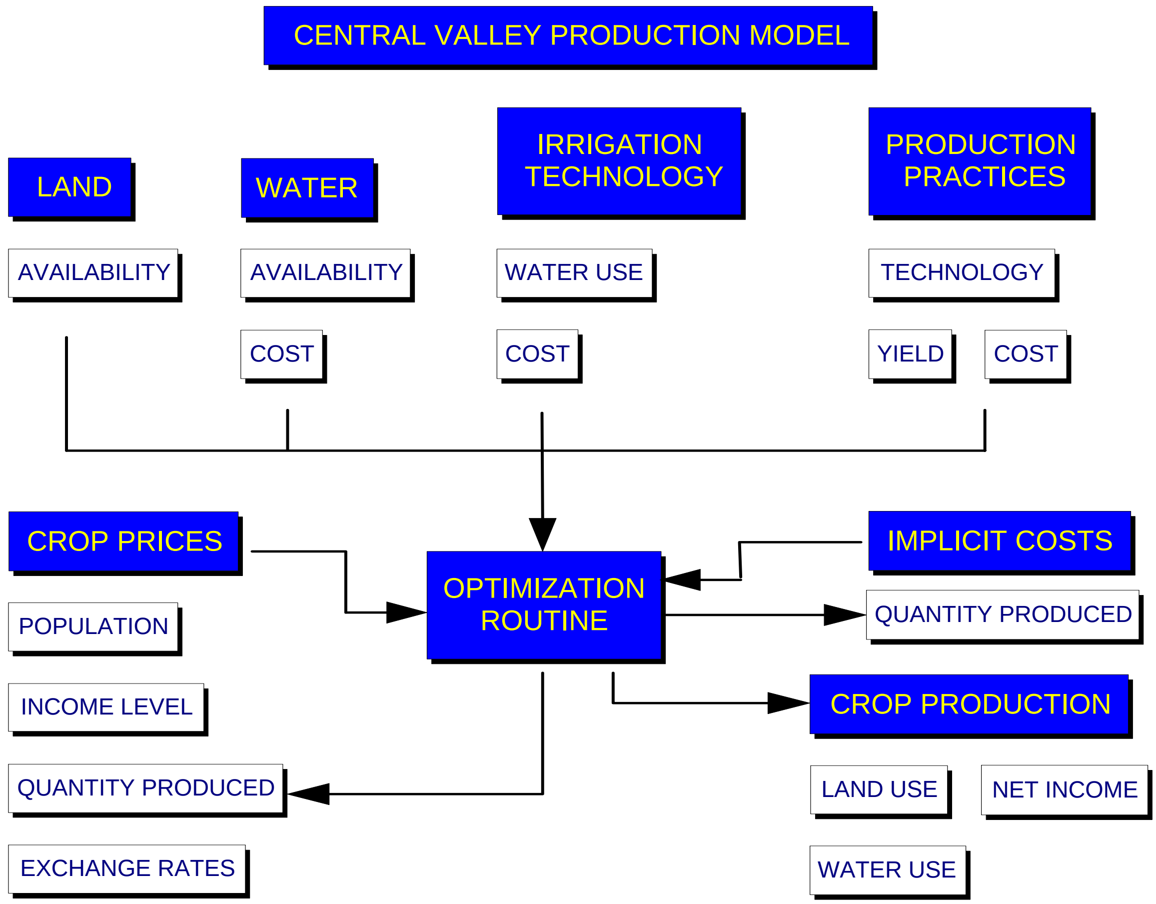
Table 18.
Crops in CVPM

CVPM CROP GROUPINGS

Category	Proxy Crop (1)	Other Crops (2)	Unit of Measure
Wheat	Wheat		Tons
Miscellaneous grain	Barley	Oats, sorghum	Tons
Rice	Rice		Tons
Cotton	Upland cotton	Pima cotton	480-lb bales
Sugar beets	Sugarbeets		Tons
Corn	Field corn	Miscellaneous field crops	Tons
Miscellaneous hay	Grain hay	Sudan grass, other silage	Tons
Dry beans	Dry beans	Lima beans	Tons
Oil seed	Safflower	Sunflower	Tons
Alfalfa seed	Alfalfa seed	Wild rice, miscellaneous seed crops	Tons
Alfalfa	Alfalfa hay		Tons
Pasture	Irrigated pasture		Animal Unit Months
Processing tomatoes	Processing tomatoes		Tons
Fresh tomatoes	Fresh tomatoes		Tons
Melons	Canteloupe	Honeydew, watermelon	Tons
Onions	Dry onions	Dry and fresh onions, garlic	Tons
Potatoes	White potatoes		Tons
Miscellaneous vegetables	Peppers	Carrots, cauliflower, lettuce, peas, spinach, broccoli, asparagus, sweet potatoes, other truck vegetables	Tons
Almonds	Almonds	Pistachios	Tons
Walnuts	English walnuts		Tons
Prunes	Prunes	Plums and apricots	Tons
Peaches	Peaches	Nectarines, pears, cherries, apples, miscellaneous deciduous fruit	Tons
Citrus	Oranges	Lemons, grapefruit, miscellaneous subtropical fruit	Tons
Olives	Olives	Figs, kiwis, avocados, pomegranates	Tons
Raisin grapes	Raisins	Table grapes	Tons
Wine grapes	Wine grapes		Tons

NOTES:
(1) Production costs, yields, and prices for this crop used in the CVPM.
(2) Acreage data for these crops summed with the proxy crop.

Figure 5.
CVPM Input Data and Logic



Shown in Figure 5 are the data used by CVPM and the model logic flows. The model uses data on land availability, water availability and cost, the cost of increasing irrigation efficiency, and the costs and yields associated with crop production for individual crops. It also uses historical information on crop production to dynamically generate "implicit" crop production costs (real-world costs not captured in the above production cost data) based on the level of crop production. This reflects the fact that when the level of production of a crop increases, the additional production is generally done under less favorable circumstances (i.e., the "easiest to do" is assumed to be done first.)

The model also dynamically generates crop prices based on the level of crop production, reflecting the fact that, for many California crops, market prices respond significantly to the amount of the crop marketed. The crop prices generated are based on the level of consumer income, population, and competitiveness in foreign markets (exchange rates.)

For the purposes of the present study, the model was used to estimate the effect on the economic value of farm production from the change in SWP/CVP water deliveries from the base case to the with project case.

The analysis was done for three water year types: wet, average, and dry. The net economic benefits of the project were developed as an average annual value by weighting by year type frequency the product of the value of the delivery and change in deliveries for each year type.

The delivery values used were based on a CVPM run done for 2020 baseline (e.g., no action) conditions for a CALFED Water Management Strategy study. Table 19 shows the results of this run in terms of the economic benefit of an additional acre-foot of supply provided by the project at the farm headgate.

Agricultural groundwater pumping under the baseline study was examined using the CVGSM groundwater model and a determination was made that pumping depth impacts observed for the study would not significantly affect the value of agricultural surface water deliveries.

The benefits of an additional supply made available at the Delta, assuming no investment in additional conveyance capacity is required, can be determined by allocating that supply to the regions and subtracting the variable cost of delivery to the farm headgate. This variable cost was estimated to range from about $8 to $36 (in 1997 dollars) depending upon the region.

Because these values were based on a DWRSIM run with assumptions specific to CALFED requirements, the CALSIM run made for the present in-Delta storage study may have generated a higher level of deliveries for the base conditions. In, addition, the unallocated M&I deliveries reallocated to agricultural users increases the base level of deliveries from CALSIM by about five percent. For these reasons, the use of the values shown in Table 19 may somewhat overstate the benefits of the supplies generated by in-Delta storage. However, to the extent that these values represent avoided local groundwater pumping costs, the CVPM results may be relatively insensitive to such a discrepancy.

Both short-run and long run responses to changes in water resource conditions were evaluated. The purpose of the long-run analysis is to estimate average economic conditions after farmers have made permanent adjustments in response to changes in water availability and economic conditions.

The purpose of the short-run analysis is to estimate acreage, crop mix, and water use during both wet and dry years, given farmers' best possible responses to above or below normal water year situations. Permanent crop planting decisions are assumed to be made in response to long-run conditions and are therefore not subject to short-run conditions in the model.

Table 19.
Computed Value of an Additional Acre-Foot of Supply at the Farm Headgate by CVPM Region and Water Year Type
(1997$)

	YEAR TYPE		
CVPM Region	WET	AVE	DRY
REG1	$38	$39	$41
REG2	$42	$42	$54
REG3	$37	$39	$50
REG3B	$37	$42	$53
REG4	$30	$32	$34
REG5	$30	$33	$34
REG6	$53	$55	$60
REG7	$40	$41	$46
REG8	$44	$44	$47
REG9	$33	$33	$36
REG10	$89	$89	$92
REG11	$31	$32	$35
REG12	$43	$38	$52
REG13	$43	$43	$60
REG14	$102	$105	$125
REG15	$67	$67	$82
REG16	$37	$39	$63
REG17	$44	$46	$74
REG18	$69	$72	$117
REG19	$102	$103	$106
REG20	$88	$90	$114
REG21	$89	$90	$111

When surface water availability is reduced, during dry years or due to long-term reductions, for example, the model simulates choosing among the following alternatives based on minimizing the impact on the economic value of farm production:

- Increased groundwater pumping
- Shifts to crops with lower water use
- Increased irrigation efficiency
- Reduced acreage planted

Table 20.
Total Agricultural Supply Benefits
(2001$)

Supply Category	TAF			Value
	SWP	CVP	Total	($1,000)
Base Allocation				
Contract Deliveries	28	3	31	$2,106
Interruptible Deliveries	13	0	13	$682
Incremental Allocation				
Contract Deliveries	0	24	24	$1,750
Interruptible Deliveries	0	1	1	$97
Subtotal				
Contract Deliveries	28	27	55	$3,856
Interruptible Deliveries	13	1	14	$779
Total	41	28	69	$4,635

Shifting out of permanent crops and increased irrigation efficiency are responses assumed to be available only in the long-run.

The availability of interruptible water is generally announced too late (typically February, but it is not unusual for an announcement to be made as early as January or as late as March) for some seasonal planting decisions because of land preparation requirements, plantings of corn, dry beans, and tomatoes are made late enough to be able to take some advantage of the availability of this supply. In many instances, the interruptible supply is used for direct or in-lieu groundwater recharge.

This type of activity is best represented by the values to supply assigned by the model in wet years. Therefore, irrespective of the year type during which the interruptible water was available, the wet year values were assumed.

In the base case (i.e., no action alternative), unallocated interruptible and unallocated contract SWP urban deliveries are allocated to SWP and CVP agricultural contractors in proportion to their deliveries under their respective contracts. The additional unallocated interruptible and unallocated contract SWP urban deliveries produced by the project are used to augment CVP agricultural contract deliveries.

Shown in Table 20 are the results for the affected CVPM regions for the change in contract deliveries and interruptible deliveries, respectively. The values shown are indexed up to the 2001 price and represent the incremental (not average) value of the supply provided by the project.

Table 21.
Expected Water Transfer Sales to Urban Users

	San Francisco Bay Region		South Coast Region	
	urban_deliv_base	urban_deliv_6000	urban_deliv_base	urban_deliv_6000
Total Transfer Quantity (TAF)	520	518	617	594
Ann. Avg. Transfer Quantity (TAF)	7	7	8	8
Total Transfer Cost ($1,000)	$91,000	$90,650	$107,975	$103,950
Ann. Avg. Transfer Cost ($1,000)	$1,247	$1,242	$1,479	$1,424

2.3.2.2.2 Agricultural Water Transfer Benefits

Also benefiting agriculture is the sale of water to urban users through market transfers. Shown in Table 21 are the total and annual expected with and without project water transfer sales to the San Francisco Bay and South Coast Regions for the 73-year hydrology used for the 2020-level analysis. With the project, income from sales to the San Francisco Region are reduced by an expected annual amount of about $5,000 while income from sales to the South Coast Region is decreased by about $58,000. The net change in the expected annual loss in value of sales due to the project was $63,000.

2.3.2.3 Summary of Agricultural Benefits

Shown in Table 22 is a summary of the benefits described above.

Table 22.
Total Agricultural Benefits

Benefit Category		Benefits ($1,000)	
Water Supply Benefits			$4,635
Water Market Sales			-$67
	San Francisco Bay	-$5	
	South Coast	-$62	
Total Agricultural Benefits			$4,568

2.3.3 Recreation Benefits

It was assumed for this study that the all of the hunting days induced by the public hunting opportunity provided by the proposed project will be new days with the exception of the existing hunting on the affected islands. “New” days are those which are not defined by visits which would have been made elsewhere in California for the same purpose anyway or just represent an enhanced experience in the same location. These days are assumed to be over and above the existing days as estimated by JSA (1995), representing a net gain after accounting for lost recreation associated with conversion of Bacon and Webb or Webb and Victoria to reservoir islands.

In contrast, it was assumed that only twenty percent of the days generated by fishing, hiking and biking, and wildlife interpretation will be new days and only ten percent of the boating days were assumed to be new.

Table 23.
Estimated Recreation Benefits

	Visitor Days		New User Factor		New Users		Unit Day Benefit	Total Benefit ($1,000)	
	Alt 1 & 2	Alt 3	Alt 1 & 2	Alt 3	Alt 1 & 2	Alt 3	$/Day	Alt 1 & 2	Alt 3
Hunting	9,019	9,019	89%	88%	8,009	7,909	$23.80	$191	$188
Fishing	9,600	12,000	20%	20%	1,920	2,400	$16.93	$33	$41
Hiking/Biking	3,000	6,000	20%	20%	600	1,200	$16.93	$10	$20
Intrepretation	30,000	30,000	20%	20%	6,000	6,000	$16.93	$102	$102
Boating	186,240	232,800	10%	10%	18,624	23,280	$16.93	$315	$394
Total	237,859	289,819			35,153	40,789		$650	$745

Shown in Table 23 are the results of the benefit calculations. Visitor days were obtained from the November 2001 Recreational Options Technical Memorandum prepared by CH2M HILL.. Unit day benefit values were obtained from the US Army Corps of Engineers Economic Guidance Memorandum 01_01, Unit Day Values for Recreation, Fiscal Year 2001.

2.3.4 Environmental Water Use Benefits

Although it was possible to evaluate mitigation and monitoring costs of the environmental actions, benefits could not be quantified for environmental releases. A partial economic value is included in the annual water supply increment component which accounted for 10% environmental water required to comply with the 1997 F&W Biological Opinion. The required releases or storage for environmental water need to be further quantified so that a monetary value can be assigned to this benefit. At present, it is difficult to give a value to the ecological benefits which will occur with the in-Delta storage project. No adjustments for habitat island releases have been included in the analysis.

Table 24.
Value of EWA Supply

Year Type	EWA Supply (TAF)	Value ($/AF)	Total Value ($1,000)
Wet	15	$130	$1,970
Average	14	$150	$2,041
Dry	8	$100	$811
Weighted Average Value	12	$130	$1,549

Shown in Table 24 are the expected contributions, by year type, to the environmental water account based on 10% of the incremental delivery amounts produced by the project. The unit values were from discussions with CALFED staff on the expected willingness-to-pay for these contributions based on year type. The weighted average value of $1,549,000 is the expected annual benefit of these contributions.

2.3.5 Summary

Provided in Table 5 is a summary of the benefit analyses described above.

Table 5.
Summary of Annual Benefits

Benefit Category	TAF			Value
	SWP	CVP	Total	($1000)
Agricultural				
Supply	41	28	69	$4,635
Water Market Transfers				
SF Bay Region [1]				-$5
South Coast Region [1]				-$62
Total	41	28	69	$4,568
M&I Supply				
SF Bay Region	7		7	$4,922
South Coast Region	36		36	$24,475
Central Coast Region	2		2	$1,106
San Joaquin Valley	4		4	$405
Total	49		49	$30,908
Environmental			12	$1,549
Total Supply Benefits	90	28	130	$37,025
Recreation				
Alt 2				$674
Alt 3				$771
Avoided Levee Maintenance Cost				
Alt 2				$700
Alt 3				$919
Total Benefits				
Alt 2				$38,399
Alt 3				$38,715

[1] Average annual quantities are much less than 1,000 AF

2.3.6 Further Benefit Analysis. Further analysis is recommended to evaluate the following benefits:

Contribution to CVPIA(b)(2). The following assumptions will be used to evaluate CVPIA(b)(2) benefits.

- The net benefits to CVPIA will be determined from the reduction in South of the Delta SWP and CVP exports due to implementation of the CVPIA requirements.

- CVPIA water banking will be considered as a benefit to the CVP.

- Any re-allocated water from urban sector can be given credit as the CVPIA water. For example, supplies turned back from SWP MWD use can be transferred to CVPIA Refuges.

Environmental Water Account (EWA) Benefits. The following assumptions were (or will be used) to evaluate EWA benefits.

- 10% of exports to be released as environmental water from DW Project as per Biological Opinion.

- The net benefit to EWA will be based on any potential benefits in addition to CVPIA and exports.

- Information on EWA actual payments in Year 2000 by State and Federal agencies will be used in conjunction with information from DWR EWA staff to assess economic value of EWA benefits.

Banking for Water Transfers. Economic value of interim banking for water transfers in in-Delta storage will be evaluated on qualitative basis.

CVPIA Benefits. Further modeling studies are required to evaluate the impact of in-Delta storage operations integration with CVPIA requirements.

Water Transfers and Banking. There are no agreements between water users which can be applied to assessment of benefits. A storage apportionment agreement needs to be developed for this project.

Chapter 3
ECONOMIC IMPACT ANALYSIS

3.1 General

The economic impact analysis was designed to identify potential gains and losses to the area local to the proposed project stemming from changes in the economy of the area due to the existence of the project. This analysis was made to disclose the potential for both positive and negative impacts to the local economy. While a economic benefit cost analysis done for economic justification purposes is traditionally done from a larger perspective (e.g., a regional or Statewide perspective) and incorporates only direct costs and benefits, an economic impact analysis considers indirect and induced local economic effects—the “ripple” effects.

For this purpose, Input-Output models designed to identify economic linkages in the local economy were employed. These linkages exist because a change in the level of any economic activity in one sector of the economy affects the level of activity of those sectors of the economy which provide it with goods and services. Farmers, for example, depend on the output of tractor manufacturers and dealers and, depending upon the crop, custom services for harvesting. Those providing custom services for harvesting, in turn, depend upon the output of harvest equipment manufacturers, equipment repair services, and fuel suppliers and so on.

I-O models, as most models, are best for evaluating relative impacts. I-O models represent a snapshot of the economy at a fixed point in time. In this case, a snapshot of the economy in San Joaquin and Contra Costa Counties. I-O analysis handles changes using fixed factors, no flexibility to adapt is assumed, with each resource unit is assumed to be as productive as any other. No allowance is made for local businesses and individuals to respond to market signals to “make the best of” the remaining opportunities in the local area or outside of the local area.

The effects generated by the Input-Output models are classified as direct (e.g., cut in farm production), indirect (e.g., reduced need for custom harvesting services), and induced. The induced effects arise from the change in income due to the direct and indirect effects. This income change affects the overall level of consumption of goods and services.

For the purposes of the impact analysis, the linkages are evaluated only in so far as they affect local economic activity. The impact on equipment manufacturers in other parts of California or other states is not included, for example. Also outside of the scope of this impact analysis are the same types of economic effects which occur in the areas benefiting from the additional water supply reliability provided by the proposed project.

Changes in local economic activity evaluated in this section arise from:

- Loss of expenditures for crop production.
- Loss of expenditures on existing levee maintenance regime.
- Expenditures on operations and maintenance of the proposed project facilities (including recreation facilities).
- Expenditures related to additional recreation days produced by the proposed project.

The impact numbers generated for these evaluations represent the sum of the direct, indirect, and induced economic effects and were developed using a MIG IMPLAN model set up for Contra Costa and San Joaquin counties. The income effects shown are for employee compensation and proprietor’s income effects, those effects directly linked to employment. Effects on employee compensation and proprietor’s income represent approximately two-thirds of total household income effects, the other third being effects on income from rental property and capital investments.

3.1.1 Loss of Crop Production

Table 3-1 shows the value of existing agricultural production and Table 25 shows the local employment and employee and proprietor income impacts of the loss of that production on each of the affected Delta islands, depending upon the alternative selected, as a consequence of the proposed project.

This production loss scenario probably overstates the size of the actual impacts, however. If the asparagus crop production lost, for example, is moved to another Delta island, the net impact would depend on the crop type it replaces in the other location. Because the replaced crop is likely to have lower associated impacts, the net impact is likely to be lower. If field corn elsewhere in the local area is replaced by the asparagus no longer grown on Bouldin Island, for example, the per-acre employment impact will be about four times lower and the income impact will be about six times lower. The migration of asparagus is problematic because the increased foreign competition for that crop may make the investment needed to produce that crop elsewhere in the area impractical.

What is not taken into account, however, is the effect of the loss of crop production on those activities related to the hauling, storage, and processing of the crops produced after they leave the farm. To the extent that these activities take place in the local area, or to extent that local hauling companies, storage facilities, and processors cannot substitute other crops, this represents a loss not captured in this evaluation. Based on a very preliminary analysis, the additional impact due to the loss of expenditures on hauling may be as large as 27 jobs and $1.5 million annual employee and proprietor income.

Table 25.
LOCAL EMPLOYMENT AND EMPLOYEE AND PROPRIETOR INCOME EFFECTS
FROM LOSS OF AGRICULTURAL PRODUCTION

Crops	Webb Tract		Holland Tract		Bouldin Island		Bacon Island		Alt 1, 2		Victoria Island		Alt 3	
	Employment	Income ($1,000)	Employment	Income ($1,000)	Employment	Income ($1,000)	Employment	Income ($1,000)	Employment	Income ($1,000)	Employment	Income ($1,000)	Employment	Income ($1,000)
Alfalfa											67	$1,254	67	$1,254
Asparagus							21	$692	21	$692	160	$5,255	182	$5,947
Corn (field)	38	$914	7	$171	66	$1,603	42	$1,005	153	$3,694	16	$386	169	$4,080
Grain sorghum							1	$18	1	$18			1	$18
Potatoes							71	$2,330	71	$2,330			71	$2,330
Safflower			13	$301					13	$301	36	$837	49	$1,138
Small grains	17	$370	11	$241	29	$606	13	$281	71	$1,498	11	$238	82	$1,736
Sunflowers							15	$350	15	$350			15	$350
Vegetables							0	$11		$11			0	$11
Total	55	$1,284	31	$713	95	$2,209	163	$4,686	345	$8,893	290	$7,971	636	$16,863

3.1.2 Gains from Operations and Maintenance of the Proposed Project Facilities

Operation and maintenance expenditures for the water supply and recreation facilities will have a positive effect on local employment and income. Table 26 shows the indirect, and induced economic gains for each alternative. The recreation plans recommended by CH2M HILL for Alternatives 1, 2 & 3 are assumed to be implemented. Table 27 reflects the fact that employment and income current levee maintenance activity will be forgone, however, when that activity is superceded by the proposed project.

Table No. 26
LOCAL EMPLOYMENT AND EMPLOYEE AND PROPRIETOR INCOME EFFECTS FROM OPERATION AND MAINTENANCE EXPENDITURES

	Expenditures ($1000)			Total Employment Generated			Total Income Generated ($1000)		
Expenditure Category	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 1**	**Alt 2**	**Alt 3**
Maintenance	$5,774	$4,325	$4,389	156	117	119	$6,172	$4,624	$4,691
Energy	$870	$960	$894	2	3	3	$182	$201	$187
Operating Staff Compensation	$1,010	$610	$610	20	13	13	$1,562	$944	$944
Total	$7,654	$5,896	$5,893	179	132	134	$7,917	$5,768	$5,822

Table No 27.
LOCAL EMPLOYMENT AND EMPLOYEE AND PROPRIETOR INCOME EFFECTS FROM THE DISCONTINUATION OF CURRENT LEVEE MAINTENANCE EXPENDITURES

	Expenditures ($1000)			Total Employment Generated			Total Income Generated ($1000)		
Expenditure Category	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 1**	**Alt 2**	**Alt 3**
Maintenance	$700	$700	$919	19	19	25	$749	$749	$983

3.1.3 Recreation Gains

3.1.3.1 Review of DW Project Proposed Recreation Days

Table 28 shows the estimated number of recreation use days that currently exist on the DW project islands. Hunting is private except for for-fee use on Holland Tract. Except for Holland Tract, fishing on the other islands occurs on the levees and is private. Two marinas exist on Holland Tract and account for the high numbers of boaters using the island. Existing hunting use days on Victoria Island was estimated to be 100 days.

Table 29 shows the estimated number of recreation use days that could be expected with the Delta Wetlands project as proposed and estimated by JSA (1995). The proposed DW recreation plan will increase the number of private hunting, fishing and other use days on the project islands.

The cost of the DW proposed recreation has been estimated at over $583 million. The proposed recreation is expected to create 80 permanent full time equivalent jobs and 13 secondary jobs in the regional economy. JSA (1995) estimated that non-local recreationists would spend $3.1 million annually. As mentioned in Section 6.0, the plan does not meet the unmet recreational needs of the Delta including fishing piers, bicycle and hiking trails, and public access points. The recreation proposed by DW is not appropriate for a public project because the benefits of the facilities are limited to private uses and the cost to construct is high.

Table No. 28.
ESTIMATED RECREATION USE DAYS ON ALL FOUR ISLANDS AS OF 1995

Island	Hunting (Use Days)	Fishing/Boating (Use Days)
Bacon Island	100	3120
Webb Tract	640	90
Bouldin Island	210	360
Holland Tract	60	57,050
Total	1,010	60,620
source: JSA 1995		

Table No. 29.
ESTIMATED RECREATION USE DAYS ON ALL FOUR ISLANDS UNDER THE DW PROPOSED RECREATION PLAN

Island	Hunting (Use Days)	Fishing/Boating (Use Days)	Other (Use Days)
Bacon Island	2591	14,589	11,137
Webb Tract	2664	14,589	11,137
Bouldin Island	8632	13,290	10,157
Holland Tract	4011	36,078	6,098
Total	17,898	78,546	38,530
source: JSA 1995			

3.1.3.2 Recreation proposed for Re-engineered DW Project.

Table 30 shows the estimated number of recreation use days that could be expected with the Re-engineered DW Project. The proposed recreation plan will increase the number of hunting, fishing, hiking, biking, and interpretative experiences currently available. In addition, all the facilities would be public rather than private.

Table No. 30
ESTIMATED RECREATION USE DAYS ON ALL FOUR ISLANDS UNDER THE RE-ENGINEERED DW PROJECT

	Hunting (Use Days)	Fishing/Boating (Use Days)	Other (Use Days)
All Islands	9,019	195,840	33,000

It is likely that the proposed hunting will create significant new hunting opportunities for the public. The fishing, boating, hiking, biking, wildlife observation and use of the interpretative center will only generate 10-20% new users.

The cost of the proposed recreation is estimated at $3.2 million. The recreation will likely generate 36 FTE jobs and expenditures by non-local recreationists will contribute $887,000 in employee and proprietor income to the local economy annually (Table 32.)

3.1.3.3 Recreation proposed for Victoria and Bacon Reservoirs and connection to Clifton Court

The recreation proposed under the Bacon and Victoria islands storage option is very similar to the Re-engineered DW Project. The plan assumes that recreation will continue on the habitat islands and on Bacon Island as proposed under the Re-engineered DW Project. The number of levee fishing access sites on Victoria Island would be increased and a levee-based hiking/biking trail could be located on each half of the island as loop trails. Table 31 shows the estimated number of recreation use days that could be expected with the Bacon Island and Victoria Island storage option.

Table No. 31.
ESTIMATED RECREATION DAYS FOR VICTORIA/BACON STORAGE OPTION

	Hunting (Use Days)	Fishing/Boating (Use Days)	Other (Use Days)
All Islands	9,019	244,800	36,000

The proposed hunting will create significant new hunting opportunities for the public as in the Re-engineered DW Project. The fishing, boating, hiking, biking, wildlife observation and use of the interpretative center will only generate 10-20% new users.

The cost of the proposed recreation is estimated at $3.6 million. The recreation will likely generate 43 FTE jobs and expenditures by non-local recreationists will generate $1.03 million in employee and proprietor income annually (Table 32.)

3.1.3.4 Recreation Gains Produced by In-Delta Storage Alternatives

The additional days of recreation generated by the proposed project will also have a positive effect on local employment and income. This arises from expenditures by recreationists in the local area. Table 32 shows the indirect, and induced economic recreational gains for each alternative. It was assumed for this study that the all of the hunting days induced by the public hunting opportunity provided by the proposed project will be new days with the exception of the existing hunting on the affected islands (see above.) “New” days are those which are not defined by visits which would have been made elsewhere in the local area or just represent an enhanced experience for visitors who would be in the same location anyway. In both of these cases, additional local expenditures are not generated.

Table 32.
LOCAL EMPLOYMENT AND EMPLOYEE AND PROPRIETOR INCOME
EFFECTS OF RECREATION EXPENDITURES

	Visitor Days		Unit Daily	New User Factor		In-Delta Expenditure	Total Expenditures ($1000)		Total Employment Generated		Total Income Generated ($1000)	
Activity Type	**Alt 1 & 2**	**Alt 3**	**Exp**	**Alt 1 & 2**	**Alt 3**	**Factor[3]**	**Alt 1 & 2**	**Alt 3**	**Alt 1 & 2**	**Alt 3**	**Alt 1 & 2**	**Alt 3**
Hunting	9,019	9,019	$40.40	89%	88%	50%	$162	$160	8	8	$201	$199
Fishing	9,600	12,000	$42.60	20%	20%	50%	$41	$51	2	3	$51	$64
Hiking/Biking	3,000	6,000	$40.40	20%	20%	50%	$12	$24	1	1	$15	$30
Intrepretation	30,000	30,000	$40.40	20%	20%	50%	$121	$121	6	6	$151	$151
Boat Visit Days	186,240	232,800	$40.40	10%	10%	50%	$376	$470	19	24	$468	$585
Total	237,859	289,819					$712	$827	36	42	$887	$1,029

[1]Based on CH2MHill Recreational Options Technical Memo (Nov 30, 2001)
[2]Based on 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (U.S. Department of the Interior
[3]Estimated from Sacramento-San Joaquin Delta Recreation Survey (1995)

In contrast, it was assumed that only twenty percent of the days generated by fishing, hiking and biking, and wildlife interpretation and only ten percent of the boating days will be new days. It was also assumed that trip expenditures within the Delta area and, therefore, affecting the local economy, were about one-half of the total trip expenditures. Not counted were expenditures outside the Delta but in nearby areas that would still be of significant benefit to the local economy.

Visitor days were obtained from the November 2001 Recreational Options Technical Memorandum prepared by CH2M HILL. California expenditure numbers were adopted from the 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation report done by the U.S. Department of the Interior. The percentage of expenditures made within the Delta was developed from information in the 1995 Sacramento-San Joaquin Delta Recreation Survey done for the California Department**.**

3.2 Net Local Employment and Income Effects

Table 33 shows the net effect on the local economy of the loss of agricultural production on the affected islands, the additional recreation expected from the proposed project, and the operations and maintenance activities which will be required to operate the water supply facilities as well as the recreation facilities. As shown in Table 27, in case of the Victoria Island (Alternative 3), adverse impact on agriculture is high. The DW Project will have minimal adverse impact because agricultural losses are offset by increased recreation and maintenance jobs and income.

Table 33

NET LOCAL EMPLOYMENT AND EMPLOYEE AND PROPRIETOR INCOME EFFECTS

	Employment			Income ($1,000)		
Effect Category	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 1**	**Alt 2**	**Alt 3**
Agricultural Production	-345	-345	-636	-$8,893	-$8,893	-$16,863
Current Levee Maintenance	-19	-19	-25	-$749	-$749	-$983
Recreation	36	36	42	$887	$887	$1,029
Operations and Maintenance	179	132	134	$7,917	$5,768	$5,822
Net Effect	-149	-196	-485	-$838	-$2,987	-$10,995

3.3 Net Local Sales Tax Revenue Effects

Shown in Table 34 are the estimated overall net fiscal effects on local public revenues from sales taxes. These values were estimated using the IMPLAN model to link the changes in local expenditures to local retail trade activity. One percent of the retail sales were assumed to be returned to the counties as sales tax revenues.

Table 34
Net Local Sales Tax Revenue Effects

	Local Sales Tax Income ($1,000)		
Effect Category	**Alt 1**	**Alt 2**	**Alt 3**
Agricultural Production	-$24	-$24	-$44
Current Levee Maintenance	-$2	-$2	-$2
Recreation	$7	$7	$8
Operations and Maintenance	$13	$10	$10
Net Effect	-$6	-$9	-$28